

REMARKS

Claims 1-20 are pending. Claims 1, 2, 5, 9, and 17 are amended. The limitations that were added to independent claim 1 were currently described in dependent claims 2 and 5, so these amendments should not require further search. Reconsideration of presently pending claims 1-20 is respectfully requested in light of the above amendments and the following remarks.

Rejection to Claims under 35 U.S.C. § 103(a), Claims 1-20

Claims 1-20 are rejected under 35 U.S.C. § 103(a) as being allegedly unpatentable over, Yamaguchi (U.S. Publication No. 2003/0232491) in view of Shih et al. (US Patent No. 6,387,761 hereinafter referred to as "Shih"). Applicants traverse this rejection on the grounds that these references are defective in establishing a prima facie case of obviousness with respect to claims 1, 9, and 17.

As the PTO recognizes in MPEP § 2142:

... The examiner bears the initial burden of factually supporting any prima facie conclusion of obviousness. If the examiner does not produce a prima facie case, the applicant is under no obligation to submit evidence of nonobviousness...

It is submitted that, in the present case, the examiner has not factually supported a prima facie case of obviousness for the following, mutually exclusive, reasons.

1. Even When Combined, the References Do Not Teach the Claimed Subject Matter

The Yamaguchi and Shih references cannot be applied to reject claims 1, 9, and 17 under 35 U.S.C. § 103(a), which provides that:

A patent may not be obtained ... if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which the subject matter pertains ... (Emphasis added)

Thus, when evaluating a claim for determining obviousness, all limitations of the claim must be evaluated. However, neither Yamaguchi nor Shih, either alone or in combination, discloses or suggests “forming a silicon dioxide gate insulator layer on said semiconductor substrate, performing a plasma nitridation procedure on the silicon dioxide gate insulator layer to form a nitrided gate insulator layer, and performing a hydrogen anneal procedure on the nitrided gate insulator layer.”

In paragraph 25, Yamaguchi discloses that “a plasma nitridation process is performed on the silicon nitride film 213 and nitrogen radicals . . . are incorporated into the silicon nitride film 213. . . . The incorporated nitrogen radicals can terminate the defects and dangling bonds within the silicon nitride film 213.” Thus, instead of performing a plasma nitridation procedure on a silicon dioxide gate insulator layer, Yamaguchi performs a plasma nitridation process on a silicon nitrided film. Therefore, Yamaguchi fails to disclose “performing a plasma nitridation procedure on the silicon dioxide gate insulator layer,” as recited in claims 1, 9, and 17.

In addition, Yamaguchi fails to disclose “performing hydrogen anneal procedure on the nitrided gate insulator layer.” In paragraph 49, Yamaguchi merely discloses “after the above nitridation process, thermal processing is performed on the substrate in a non-oxide gas atmosphere comprising passive gas such as N₂, He, Ar, Kr, or Xe, for example, as shown in the process step of FIG. 3D.” Thus, instead of performing a hydrogen anneal procedure, Yamaguchi performs a thermal process in an atmosphere with passive gases. Therefore, Yamaguchi also does not disclose “performing a hydrogen anneal procedure on the nitrided gate insulator layer,” as recited in claims 1, 9, and 17.

Shih also does not disclose such features. At column 3, lines 55-65, Shih discloses that “the first step. . . is to nitridate substrate 200 to form a thin silicon nitride barrier layer 205 on the bottom electrode 206. . . . The purpose of silicon nitride barrier layer 205 is to form an oxidation prevention barrier layer for bottom electrode 206. In this way oxygen cannot penetrate grain boundaries of polysilicon electrode 206 and form oxides therein which can lead to a decrease in the effective dielectric constant of the capacitor dielectric and to increase in electrode resistance.” Thus, instead of performing a nitridation on a silicon dioxide gate insulator layer, Shih performs

a nitridation on a silicon substrate. In addition, Shih teaches away from performing a plasma nitridation on a silicon oxide gate insulator layer by specifically teaching that the silicon nitride barrier layer prevents oxygen from penetrating the bottom electrodes. Therefore, Shih does not and would not disclose “performing a plasma nitridation procedure on the silicon dioxide gate insulator layer,” as recited in claims 1, 9, and 17.

Thus, for this mutually exclusive reason, the examiner’s burden of factually supporting a *prima facie* case of obviousness has clearly not been met, and the rejection to claims 1-20 under 35 U.S.C. §103(a) should be withdrawn.

2. Prior Art That Teaches Away From the Claimed Invention Cannot be Used to Establish Obviousness

In the present case, the Shih reference, by specifically teaching that the silicon nitride barrier layer prevents oxygen from penetrating the bottom electrodes, teaches away from performing a plasma nitridation procedure on the silicon dioxide gate insulator layer, as recited in claims 1, 9, and 17 above.

Since it is well recognized that teaching away from the claimed invention is a *per se* demonstration of lack of *prima facie* obviousness, it is clear that the examiner has not borne the initial burden of factually supporting any *prima facie* conclusion of obviousness.

Thus, for this reason alone, the examiner’s burden of factually supporting a *prima facie* case of obviousness has clearly not been met, and the rejection to claims 1-20 under 35 U.S.C. §103(a) should be withdrawn.

3. The Combination of References is Improper

Neither Yamaguchi nor Shih discloses, or even suggests, the desirability of the combination of “performing plasma nitridation procedure on a silicon dioxide gate insulator layer” and “performing a hydrogen anneal procedure on the nitrided gate insulator layer.” Yamaguchi merely discloses performing a plasma nitridation procedure on a silicon nitride film, not silicon dioxide. In addition, there is no mention of performing a hydrogen anneal procedure

on the nitrided film. Instead of performing a hydrogen anneal procedure, Yamaguchi performs a thermal process in an atmosphere with passive gases. Shih also fails to disclose or suggest performing a plasma nitridation procedure on a silicon nitride film. Shih merely disclose performing a nitridation process on a silicon substrate, not a silicon dioxide, to form a silicon nitride barrier layer. Shih teaches away from silicon dioxide by specifically teaching that silicon nitride barrier layer prevents oxygen from penetrating the bottom electrodes. Therefore, neither Yamaguchi nor Shih discloses or suggest the features of claims 1, 9, and 17. One of ordinary skill in the art would not have been led to either modify or combine the disclosures of Yamaguchi and Shih to reach the features of claims 1, 9, and 17.

Even, arguendo, if a person of ordinary skill in the art were to modify or combine the disclosures of Yamaguchi and Shih, the resulting combination still would not be performing a plasma nitridation procedure on a silicon dioxide gate insulator layer, since neither reference discloses such layer. Therefore, one of ordinary skill in the art would not have been led to modify or combine the disclosures of Yamaguchi and Shih to reach the features of claims 1, 9, and 17.

In this context, the MPEP further provides at § 2143.01:

The mere fact that references can be combined or modified does not render the resultant combination obvious unless the prior art also suggests the desirability of the combination.

In the above context, the courts have repeatedly held that obviousness cannot be established by combining the teachings of the prior art to produce the claimed invention, absent some teaching, suggestion or incentive supporting the combination.

In the present case it is clear that the examiner's combination arises solely from hindsight based on the invention without any showing, suggestion, incentive or motivation in either reference for the combination as applied to claims 1, 9, and 17. Therefore, for this mutually exclusive reason, the examiner's burden of factually supporting a *prima facie* case of

obviousness has clearly not been met, and the rejection to claims 1-20 under 35 U.S.C. §103(a) should be withdrawn.

Conclusion

It is clear from all of the foregoing that independent claims 1, 9, and 17 are in condition for allowance. Dependent claims 2-8, 10-16, and 18-20 depend from, and further limit, independent claims 1, 9, and 17 and therefore are allowable as well.

An early formal notice of allowance of claims 1-20 is requested. The Examiner is invited to call the undersigned at the below-listed telephone number if a telephone conference would expedite or aid the prosecution and examination of this application.


Respectfully submitted,



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